DESCRIPTION OF THE PLATE.

FIG. I.—A. Femoral artery, above the tumour.
B. Artery below the tumour. This is shown a little larger than it is in the preparation.
C. Large anastomosing branch passing around upon the inside of the knee.
D. Smaller branches.
E. First branch given off below the tumour.
F. Femoral vein, of the natural size, with many branches, which are not shown.
G. Popliteal nerve.
H. Condensed membrane of a firm fibrous texture, filling up the space between the extremities of the artery, and involving the vein. This was about three-fourths of an inch thick, and was all that remained of the aneurismal tumour. There was nothing of it between the ends of the artery that could be distinguished as arterial texture.

FIG. II.—This shows at A, the size and form of the inside of the artery, the injected material being laid bare by an incision through the coats of the artery.

ART. II.—*On Digestion of Fatty Matters by the Pancreatic Juice.* By S. JACKSON, M. D., Professor of Inst. Med. in the University of Pennsylvania.

THE different digestions or chemical processes to which the different kinds of food—albuminous, oleaginous, saccharine, or amylaceous—undergo in the alimentary canal, have been the subject of repeated investigation and experiment since Spallanzani first demonstrated them to belong to the domain of chemico-physical science.

Prout determined the differences in the nature of the alimentary substances. His observations were followed by the more accurate researches of Mulder, Dumas, Becquerel, Liebig, and the pupils of the Geissen school. They investigated the chemical elementary composition, the modes of production, decomposition, metamorphoses, and other relations of those substances. The way was thus opened for acquiring a more correct knowledge of the kind of chemical process, or digestion, appropriate to each kind of aliment, and the seat or organ in which it occurred.

Approximations are being made to the solution of these interesting problems, which are not devoid of practical importance. They still remain unsettled and obscured from the conflicting statements, as to facts, of different observers, entitled equally to confidence from their intelligence, skill, and truthfulness.

It is not my intention to enter on the general question of the alimentary digestions. I shall confine myself to one alone, that of the oily or fatty matters, respecting which there exist opposing statements as to the observation of a simple phenomenon, which is, however, the principal fact of the process.

MM. Cl. Bernard and Bousingault, and Bouchardat and Sandras, had shown that these substances were converted into an emulsive fluid. This emulsion, absorbed by the lymphatics of the villi (to which the term lacteals, in my opinion, alone is properly applicable), constitutes the milk-like fluid, named chyle, found in the lymphatics of the mesentery after a meal containing oleaginous principles; and at no other time. If the term chyle is restricted to this milk-like fluid, which gave origin to it, then chyle is not the general product of digestion, as it is generally supposed to be, but is the fatty matters of the food in a state of emulsion, and nothing more.

Subsequently, M. Cl. Bernard demonstrated that this emulsion is produced by the action of the pancreatic juice: and he assumed it to be the essential agent in its formation. This demonstration appeared conclusive, from one of the most neat and beautiful observations in physiology.

It is known that in the rabbit, the insertions of the hepatic and pancreatic ducts in the duodenum, are separated by an interval of near six inches. M. Bernard availed himself of this fact to observe, in nature—in situ—the seat and act of the conversion of fats into an emulsion. He accordingly introduced into the stomach of rabbits, after fasting, some oil along with green food, and after the lapse of a period of time, not related, the animals were opened, and the intestines exposed. No chyle or emulsion of fats was found in the mesenteric lymphatics at and below the opening of the hepatic duct, while they were distended with the chylous or fatty emulsion at and below the insertion of the pancreatic duct. Further, when the pancreatic juice is added to sweet-oil or other fluid fat, an emulsion is instantly produced; and this emulsion is very perfect and permanent. The conclusion from this experiment was, that the emulsion of the oil was the immediate result of the action of the pancreatic juice.

The correctness of this observation of M. Bernard, has been denied by MM. Bidder, Schmidt, Lehmann, Donders, and Herbert. It is asserted that M. Bernard was misled by not properly timing his observations. It is stated, that if the animal be examined one or two hours after the ingestion of oil into the stomach, the lymphatics between the biliary and pancreatic ducts are then tinged with white fatty emulsion, which, consequently, is formed independent of the pancreatic fluid. When the examination is delayed for five or six hours after the introduction of oil into the stomach, it is alleged that the emulsion formed in the upper portion of the duodenum has then descended, and the portion absorbed has disappeared from the lymphatics, having passed on to the thoracic duct. By this time, the emulsion having reached the region of the pancreatic duct, and passed into the jejunum, the lymphatics of the mesentery of this part of the intestines are necessarily turgid with emulsified fat. It is inferred, therefore, that M. Bernard did not examine the animals on which he experimented under the period of five or six hours after giving the oil, and was thus led into a misrepresentation of the true character of the phenomena.

This simple fact, it would seem, ought to be settled without difficulty; but the reports of those who have observed the phenomena are entirely adverse to each other. My engagements in the practice of my profession interfere with experimental researches; they prevent the application of time requisite to success in experiments. Dr. James Corse obligingly offered to perform the experiments for me, submitting to my observations the phenomena on the opening of the animals.

The following are the results of this investigation:—

A number of rabbits were procured. They had been fed for some days on hay. Four of them were deprived of food for three days. Three drachms of fresh sweet-oil were then introduced into the stomach of each animal, through a tube, successively, at nine, ten, eleven, and twelve o'clock, and immediately fed with some peas. At 2 P. M., varying from five to two hours after giving the oil, they were made insensible with sulphuric ether, the abdomen opened, and the intestines and mesentery spread out.

In one only had any emulsion of the oil been formed. In that one the mesenteric lymphatics, commencing half an inch below the pancreatic duct, were turgid with white emulsive fluid. Not a single lymphatic could be seen in the transparent mesentery between the pancreatic and hepatic ducts.

On examining the stomachs, they were found distended, in each rabbit, with a green, comminuted mass of vegetable matter, which must have proceeded from the hay on which they had been previously fed, and had remained undigested. In one, a portion of the oil was free in the stomach. In all the others, most of it appeared to have been absorbed and retained by the large vegetable bolus filling up the stomach.

The above experiments indicate a source of fallacy in making this observation. The food on which the animal has fed may interfere with its passage through the stomach, and cause a longer retention of it there than is suspected.

Second Series of Experiments.—To obviate the cause of failure in the preceding experiments, the remainder of the rabbits were fed for eight days on green cabbage. It was found that they suffered, and two died, under this exclusive aliment. It was necessary to add wheat-bran, which was eaten with avidity, and soon restored them to a good condition.

Four more were selected and kept without food for two days. They were then fed with cabbage saturated with sweet-oil, at intervals, from 9 A. M. until 2 P. M. In this manner oleaginous matter was constantly entering the digestive apparatus for five hours, until the moment of observation. If oils are emulsified in the stomach or duodenum, independent of the pancreatic juice, the lymphatics above the connection of the pancreatic duct, would, of course, be found to contain the emulsion.

The animals were destroyed by the same process as in the foregoing experiments.

The first rabbit was feeding up to the time it was killed. The lymphatics between the hepatic and pancreatic ducts were invisible, except two, from four to six lines above the pancreatic duct. They appeared as faint white lines. Below the pancreatic duct they were distended with chyle.

The second rabbit, under the same circumstances, presented the same appearances. No chyle was contained in the lymphatics until within a few lines of the pancreatic duct, where two or three were faintly visible. Below the duct they were turgid with chyle.

The third, a well-grown rabbit, gave precisely the same results. There was no appearance of chyle in the lymphatics of the mesentery, except within a few lines of the pancreatic duct, while below they were well filled with the emulsive fluid.

The fourth, also a large, strong animal, presented corresponding appearances. No chyle in the lymphatics, from the commencement of the duodenum until within a few lines of the pancreatic duct; below it they were distended with milky emulsion.

The above experiments corroborate the observations of M. Cl. Bernard, as respects the phenomena in rabbits, and do not accord with the statements of the German physiologists, MM. Bidder and Schmidt, Lehmann, and Frerichs.

An experiment relied on by MM. Schmidt, Bidder, Lehmann, and Frerichs, in opposition to M. Cl. Bernard, is wholly inconclusive. After tying the pancreatic duct in one instance, and the small intestines below the pancreatic duct in another, milk, or milk with olive-oil, was injected into the intestines, "and the lacteals were filled with white chyle." This was to be expected. What is the necessary condition for the absorption by the lacteals of the villi of fatty substances? That they exist as an emulsion. Milk is a natural emulsion, holding a fatty substance (cream) in suspension, and consequently in the condition for absorption. Milk forms an emulsion with oils, and creates the same condition. Still more extraordinary is the experiment of Frerichs, quoted against M. Bernard by Lehmann, in which he injected an *emulsion of oil and albumen* into the ligated intestine, and its absorption was considered as a refutation of M. Cl. Bernard's doctrine.

The albumen of egg forms a most perfect and a persistent emulsion with oils. The pure pancreatic juice does the same. This I have witnessed, and can state that the oil does not "soon separate again on the surface," as Lehmann asserts. The pancreatic juice, as Lehmann shows, differs very slightly from pure albumen. No other intestinal fluid possesses this character so strongly, and no other is as well adapted to emulsify the fats of our aliment.

The cystic bile is viscid from containing a larger amount of mucus derived from its mucous membrane, and by agitation forms an emulsion with oils. This emulsion has always appeared to me very inferior to that obtained from pure pancreatic juice, or albumen of egg. Neither is it as persistent, the oil beginning in a few hours to separate. The hepatic bile is much thinner and contains much less mucus. It is unknown whether it will form an emulsion with fats. It may be considered as very doubtful. No positive facts are known as to the quantity of cystic bile that enters into the duodenum during digestion. The probability is, that it is very small in comparison to the amount of freshly secreted hepatic bile coming directly from the liver. This view gives additional confirmation to M. Bernard's doctrine.

The liquid albuminose resulting from the digestion of the albuminous principle of the food, which is found often in the intestinal canal during digestion, may, from its accidental presence, concur occasionally in the formation of the emulsion of oils. The pancreatic juice is, in the present state of our knowledge of the facts, the only intestinal humour that can exercise this office as a permanent function.

I recall a circumstance, now some twenty years past, an interesting fact in this discussion, which, at the time, was inexplicable. I assisted Dr. John Webster, late Professor of Anatomy in Geneva Medical College, in the autopsy of one of his patients, who had died after long suffering, and in a state of extreme marasmus, from severe and intractable dyspeptic symptoms. Cream had been the principal nutriment for several weeks, as rarely any other food would be retained. The disease proved to be a scirrhus of the pancreas. The colon was filled with a large quantity, some two or three pounds, of a yellow fatty substance, resembling a mixture of yellow ochre and butter. A large proportion of the fatty bodies of the cream had undergone no emulsive action from the absence of the pancreatic juice, and were not absorbed.

M. Cl. Bernard came to the conclusion that the fats were decomposed by the pancreatic juice. This is not probable. The emulsion of fats is a physical, not a chemical process. It consists of the mechanical division of fats into the minutest globules, each coated with a delicate film of the emulsifying body—albumen in chyle—casein in cream. If the experiment of Bouchardat and Sandras be correctly reported, it is conclusive on this point. They gave to a dog a considerable quantity of sweet almond-oil. After some hours the animal was killed. Some of the oil, unchanged, was found in the stomach and intestines. The lacteals were filled with white chyle, as also the thoracic duct. A portion obtained from this last was treated with sulphuric ether, and the almond-oil was obtained unchanged in its properties.

The principal fact relied on by the above German physiologist to controvert M. Bernard's theory of fatty decomposition by the pancreatic juice, is of no value. Butter was given to cats and dogs, and butyric acid was sought for, but not found in the intestines. This is considered as proof that the butter was not decomposed. It proves nothing of the kind. Butyric acid readily decomposes. It cannot resist the activity of the numerous chemical reactions at work in the alimentary canal during digestion. Lactic acid is being formed incessantly in the lungs and intestines from the metamorphosis of glucose, sugar, and starch; it is as speedily decomposed. The same occurs with the bile. In the fecal matters, in a normal state of the bowels, very little of the biliary constituents, other than the colouring matter, is to be found. The conjugate biliary acids—glyco-cholic and tauro-cholic—disappear and are destroyed. Glycocol is not found; taurin, occasionally detected in the middle of the alimentary tract, disappears at the lower portion. The albuminous materials of the food that pass beyond the stomach, are metamorphosed in the intestines. In this conflict of molecular and chemical reactions, it would be impossible for butyric acid to exist. Its absence is no evidence that it was not eliminated.

The strongest objection to M. Bernard's doctrine is, that in an emulsion of oil formed with pure albumen the fatty body is not decomposed. An emulsion is a physical, not a chemical process.

It consists in the reduction of oil to the minutest particles—globulets—each covered with a coat of albumen when it is the emulsifying body. This is all that is required to impart to fats the capacity for absorption into, and their passage through tissues.

The adoption of M. Bernard's doctrine involves an inexplicable difficulty. If the neutral fats are decomposed by the pancreatic juice before, or at the time of absorption, as they are found to exist in the adipose tissue in their original state of neutral fats, they must be recomposed again in the blood, or at the instant of their secretion. To accomplish this change there must be a generation of oxide of lipyl and glycerin, the bases of neutral fats. It is difficult to understand how it can occur. It is true, Mulder has offered a very ingenious hypothesis to show the possibility of the formation of those bodies, in the economy, from lactic acid. But the whole matter is so entirely hypothetical, in its present state, that it does not comport with the more rigid canons of modern medical philosophy, and cannot be accepted.

The state of our knowledge may be summed up in the following conclusions:—

1. Liquid fats are not miscible with the aqueous albumino-saline fluid—liquor sanguinis—with which all the vascular tissues are saturated; it cannot enter their pores, and consequently cannot be absorbed.

2. Liquid fats, when emulsified by albumen, are reduced to minute particles, each coated with albumen. In this state they are miscible with the liquor sanguinis, moistening the tissues, can enter their pores, and are then capable of absorption. This is the sole condition requisite for the absorption of fats.

3. The white milk-like fluid, named chyle, is this emulsion of the fatty matters of the food mixed with the ordinary lymph always contained in the lymphatics of the alimentary canal, and other abdominal organs and mesentery. The molecular base of Gully is the microscopic appearance in the chyle of the minute globulets of fat coated with albumen.

4. Albumen forms a perfect and persistent emulsion with oils. The pancreatic fluid is a saturated albuminous solution, and forms with oils an emulsion equally as perfect and permanent as that of albumen.

5. The pancreatic juice is the only highly albuminous fluid in the alimentary canal, that can accomplish the formation of a perfect emulsion; and the opinion of M. Cl. Bernard, that this process is one of its functions, is, it appears to me, sustained.

6. The observations of M. Cl. Bernard, that the formation of the emulsion of fats in rabbits, is at and below the pancreatic duct, and not above it, is confirmed by the experiments reported in this communication. And, further, that the experiments on rabbits are the most reliable, as being a true exemplification of the natural process, unattended with violence and torture to the animals, more or less disturbing in their effects.

7. That M. Cl. Bernard's view of the decomposition of fats by the pancreatic juice is not proved, is opposed by the nature of the process, and by analogy with other emulsions: it is unnecessary to the accomplishment of the absorption of fats, and introduces other and complicated processes that are unknown to exist, and are mere hypotheses.

ART. III.—*On the Gastric Juice, and its Office in Digestion.* By JOHN C. DALTON, Jr., M. D., New York.

THOUGH the gastric juice has been more fully and perhaps more successfully studied than any other of the digestive fluids, there are still some contradictory statements with regard to it, even among authors of the first eminence. Since the admirable observations of Dr. Beaumont on the person of Alexis St. Martin, the secretion has been examined, on the lower animals, by Blondlot, Schwann, Wasmann, Bernard, Lehmann, and others, whose researches have, in most essential points, confirmed those of the American observer. During the past year, I have studied the gastric juice, at various times, by means of fistulæ, artificially established in the stomach of the dog, after the method of Blondlot and Bernard. The secretion was almost always obtained by feeding the animal with raw or cooked meat, after a twelve hours' fast, and collecting and filtering the fluid that ran from the fistula during the first half hour afterward. The statements of Dr. Beaumont with regard to the intermittent character of the secretion were always found to be correct. The stomach, in the intervals of digestion, contains only a colourless mucus, usually alkaline in reaction, though sometimes neutral. The acid fluid begins to run by drops in about five minutes after the introduction of food, and in ten to fifteen minutes it flows freely—occasionally in a small stream—from the orifice of the fistula. It then runs so fast that four or five ounces can be collected from a medium-sized dog in the course of half an hour. During the first five minutes of its flow it is sometimes colourless, but afterward it